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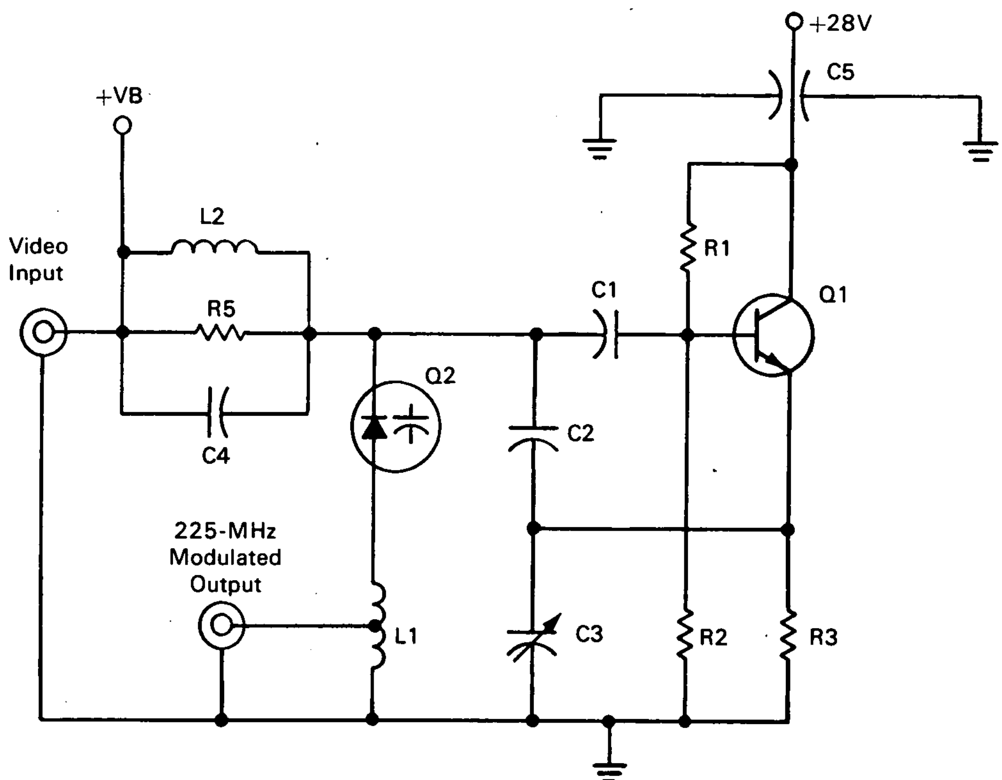
NASA TECH BRIEF

A 225 MHz FM Oscillator with Response to 10 MHz



A frequency-modulated transistor oscillator has been designed for application in wideband television transmitters. Tests on an experimental 225-MHz FM oscillator circuit showed that the design met all specification requirements. Frequency stability was within 1.0 percent over the temperature range of –25° to 85°C. Output power of approximately 120 mW into a 50-ohm resistive load was easily obtained. The baseband modulation response was flat within ±0.5 dB from dc to 10 MHz. A modulation constant of approximately 1.2 MHz/V was achieved with excellent linearity, and the oscillator exhibited very little spurious amplitude modulation.

The design effort included a theoretical analysis of the oscillator. A mathematical model of the circuit adequately predicted the oscillation frequency, and an iterative computer program yielded results that agreed closely with the slope of the deviation characteristic measured experimentally. This analytical technique could be employed to aid in the design of

(continued overleaf)

other oscillators and to analyze existing circuits. The technique might possibly be applied to existing oscillators in order to eliminate frequency drift due to temperature changes.

The oscillator circuit, represented in the schematic, is of the LC Colpitts type. This tank circuit configuration will provide near-sinusoidal output waveforms even when excited by nonsinusoidal currents. The circuit also provides a high rate of phase change at the resonant frequency, which has the effect of producing good frequency stability.

A common-collector configuration for the transistor (Q1) is used primarily because the collector is internally connected to the case. Thus, the combined effects of case capacitance to ground and heat sink capacitance to ground are an aid, rather than a hindrance, for effective rf grounding of the collector.

The varactor (Q2) is located in series with the coil because unusual modulation response was often observed when the varactor was placed in parallel with the tank circuit. At high frequencies there is sufficient internal inductance and lead inductance to cause the varactor to enter the series resonant mode. If this condition is allowed to exist, a drastic reduction in Q will occur producing unpredictable modulation response.

The problem of injecting the modulation signal and the bias voltage to the varactor was solved by the use of a series trap tuned to 225 MHz and a blocking capacitor C1. This trap, composed of L2,R5, and C4, presents a low impedance to modulation frequencies and a high impedance to 225 MHz. The design premise for such a trap in a modulated oscillator was that the Q of the trap should have a low value. This restriction was made to avoid undue attenuation of the resulting sidebands back through the trap and the video amplifier to ground.

The dc biasing network is of a conventional nature. The transistor was biased at approximately 40 mA collector current with V_{CE} at approximately 15 V. This arrangement will force the transistor to operate at a point which will tend to produce small-signal class-A oscillation.

Note:

Requests for further information may be directed to:

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